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The Accuracy of IMF and OECD Forecasts for G7 Countries

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ABSTRACT

This paper analyses the size and nature of the errors in GDP forecasts in the G7 countries from 1971 to 1995. These GDP short-term forecasts are produced by the Organization for Economic Cooperation and Development and by the International Monetary Fund, and published twice a year in the *Economic Outlook* and in the *World Economic Outlook*, respectively. The evaluation of the accuracy of the forecasts is based on the properties of the difference between the realization and the forecast. A forecast is considered to be accurate if it is unbiased and efficient. A forecast is unbiased if its average deviation from the outcome is zero, and it is efficient if it reflects all the information that is available at the time the forecast is made. Finally, we also examine tests of directional accuracy and offer a non-parametric method of assessment. Copyright © 2000 John Wiley & Sons, Ltd.

KEY WORDS forecast evaluation; macroeconomic forecast

INTRODUCTION

Over the last few years many national and international organizations have produced reports aimed at analysing the economic situation and at providing forecasts for the future evolution of the main macroeconomic figures. The purpose of this paper is to examine the size and nature of the errors in GDP forecasts in the G7 countries from 1971 to 1995. These GDP short-term forecasts are produced by the Organization for Economic Cooperation and Development (OECD) and by the International Monetary Fund (IMF), and published twice a year in the *Economic Outlook* and in the *World Economic Outlook*, respectively.

An analysis of the economic forecasts produced by the OECD, the IMF and by other organizations reveals that: (1) the forecasts made by economists linked to different organizations and institutions tend to be suspiciously similar; (2) these forecasts are usually incorrect, that is, substantial differences arise between the forecasts and the final economic growth; (3) there is a generalized belief that the events which occur in the present will be repeated in the future (the economists are 'momentum-followers' who believe today's events will reoccur tomorrow); and (4)

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the economic forecasts tend to be very conservative, avoiding taking risks when it comes to making diagnoses on the future evolution of an economy. To address these points, this article performs an evaluation of the accuracy of the forecasts, and analyses whether these international organizations have a tendency to 'clump' (make similar forecasts).

The evaluation of the accuracy of the forecasts is based on the properties of the difference between the realization and the forecast. A forecast is considered to be accurate if it is unbiased and efficient. A forecast is unbiased if its average deviation from the outcome is zero, and it is efficient if it reflects all the information that is available at the time the forecast is made. Finally, we also examine tests of directional accuracy and offer a non-parametric method of assessment.

Several studies of the accuracy of forecasts have appeared in the literature, and the pioneering work of Gartaganis and Goldberger (1955), Zellner (1958), Morgenstern (1963) and Stekler (1967, 1968) can be mentioned, together with the more recent studies by Howrey (1978, 1984), Mankiw *et al*. (1984), Nordhaus (1985), Mankiw and Shapiro (1986), McNess (1986), Mork (1987), Holden and Peel (1988), Artis (1988, 1996), Wallis (1989), Holden (1990, 1997), Stekler (1991, 1994), Barrionuevo (1993), Kolb and Stekler (1993), Brodsky and Newbold (1994), Leitch and Tanner (1995), Rathjens and Robins (1995) and Graham (1996), all of which refer to the United States and United Kingdom economies.

This paper proceeds as follows. The next section examines GDP short-term forecasts produced by the OECD and the IMF and evaluates the accuracy of these forecasts, the third section examines tests of directional accuracy and the results are summarized in the final section.

FORECASTING ACCURACY

Two sets of projections are examined: the current-year forecasts prepared in the spring of the same year, and year-ahead forecasts made in the fall for the following year. The GDP short-term forecasts used in this paper are produced by the OECD and the IMF, and published twice a year in the *Economic Outlook* and in the *World Economic Outlook*, respectively. The sample period is 1971–95 for the current-year forecasts and 1973–95 for the year-ahead forecasts.

The OECD forecasts for the current year appear in June, while those of the IMF are published in May. On the other hand, the one-year-ahead forecasts are published in December by the OECD and in October by the IMF. Hence, it can be said that the forecasts of both organizations are done in the same time horizon. In this work are used the OECD forecasts from the *Economic Outlook* of the OECD, and the IMF forecasts are extracted from the *World Economic Outlook* and from Artis (1996).

Table I presents the values of several traditional measures of goodness of forecast with respect to the final value. The statistical indicators used are root mean square error (RMSE), mean absolute error (MAE) and Theil's U.[1]

[1] Theil's U is calculated according to the following formula:

$$U = \frac{\sqrt{\Sigma(R - F)^2}}{\sqrt{\Sigma R^2}}$$

where R are the actual values and F the fitted values.

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Table I. Measures of goodness of forecasts

	Current-year forecast					
	OECD			IMF		
	MAE	RMSE	*U*	MAE	RMSE	*U*
United States	0.84	1.08	0.29	0.91	1.16	0.32
Japan	1.23	1.75	0.35	1.29	1.85	0.37
Germany	1.10	1.24	0.41	1.28	1.46	0.48
France	0.81	1.03	0.33	0.87	1.09	0.36
Italy	1.19	1.59	0.58	1.18	1.51	0.56
United Kingdom	0.78	0.95	0.37	0.95	1.12	0.41
Canada	1.08	1.24	0.34	1.18	1.42	0.38
	Year-ahead forecast					
	OECD			IMF		
	MAE	RMSE	*U*	MAE	RMSE	*U*
United States	0.91	1.08	0.34	1.19	1.54	0.45
Japan	1.33	2.15	0.47	1.73	2.62	0.52
Germany	1.55	1.81	0.66	1.54	1.85	0.63
France	1.13	1.48	0.52	1.19	1.64	0.55
Italy	1.54	1.95	0.66	1.52	2.02	0.73
United Kingdom	1.57	1.94	0.79	1.63	2.05	0.84
Canada	1.52	1.77	0.52	1.49	1.86	0.51

Note: MAE = mean absolute error, RMSE = root mean square error, U = Theil's U.

From the results it can be seen that the forecasts made by the OECD and the IMF show similar errors, although in all cases, except for the predictions for the Italian economy in the current year, the forecasts by the OECD are slightly better than those of the IMF. Also, the errors increase when the forecast of the growth rate is made with a longer time horizon. The summary statistics clearly support the propositions that OECD forecasts are superior to the IMF forecasts; that current-year forecasts are better than the longer-term year-ahead projections; and the most accurate forecasts for the current year are for the United States, France and the United Kingdom, and for the year-ahead forecasts for the United States and France.

Table II provides the values of goodness of forecasts for two samples, where the main sample is halved by breaking it at 1983. One of the most important conclusions which can be drawn from this research is that it cannot be agreed that in all cases the OECD and IMF forecast accuracy has improved in the last few years, because in some countries it can be observed how the forecasts made in the first subperiod are higher than those in the second. Finally, the summary statistics reviewed here do not afford a basis for a strong verdict either way on whether forecasting errors have fallen over the period. These results are consistent with those obtained recently by Artis (1996) for the IMF forecasts.

This paper evaluates the accuracy of a forecast based on the properties of the forecast error. A forecast is considered to be accurate if it is unbiased and efficient. A forecast is unbiased if its average deviation from the outcome is zero. Bias may be identified with the significance of the

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Table II. Measures of goodness of forecasts. A comparison of two subperiods

		Current-year forecast					
		OECD			IMF		
		MAE	RMSE	*U*	MAE	RMSE	*U*
United States	1971–1982	1.05	1.35	0.32	0.98	1.33	0.31
	1983–1995	0.64	0.73	0.23	0.84	0.98	0.33
Japan	1971–1982	1.75	2.37	0.38	1.93	2.50	0.40
	1983–1995	0.74	0.87	0.24	0.70	0.93	0.29
Germany	1971–1982	1.13	1.29	0.38	1.26	1.43	0.40
	1983–1995	1.07	1.19	0.46	1.31	1.48	0.61
France	1971–1982	0.81	1.04	0.26	0.71	0.91	0.23
	1983–1995	0.80	1.01	0.49	1.02	1.23	0.63
Italy	1971–1982	1.75	2.12	0.68	1.64	1.97	0.64
	1983–1995	0.67	0.83	0.35	0.76	0.90	0.39
United Kingdom	1971–1982	0.74	0.87	0.34	0.75	0.91	0.31
	1983–1995	0.81	1.02	0.40	1.14	1.29	0.52
Canada	1971–1982	0.96	1.18	0.29	1.08	1.42	0.33
	1983–1995	1.20	1.29	0.40	1.28	1.42	0.46
		Year-ahead forecast					
		OECD			IMF		
		MAE	RMSE	*U*	MAE	RMSE	*U*
United States	1973–1982	0.93	1.04	0.29	1.39	1.82	0.47
	1983–1995	0.90	1.11	0.39	1.03	1.30	0.43
Japan	1973–1982	1.78	2.92	0.51	2.26	3.47	0.55
	1983–1995	1.00	1.28	0.37	1.32	1.68	0.46
Germany	1973–1982	1.59	1.99	0.62	1.81	2.15	0.62
	1983–1995	1.51	1.66	0.71	1.33	1.59	0.65
France	1973–1982	1.05	1.48	0.41	0.92	1.45	0.40
	1983–1995	1.19	1.48	0.71	1.40	1.78	0.78
Italy	1973–1982	2.42	2.70	0.76	2.15	2.65	0.86
	1983–1995	0.86	1.06	0.45	1.03	1.33	0.53
United Kingdom	1973–1982	1.62	2.15	0.84	1.61	2.17	0.84
	1983–1995	1.53	1.76	0.74	1.65	1.95	0.83
Canada	1973–1982	1.41	1.80	0.47	1.25	1.88	0.47
	1983–1995	1.60	1.75	0.57	1.67	1.84	0.56

Note: MAE = mean absolute error, RMSE = root mean square error, U = Theil's U.

mean forecast error, as indicated by a simple regression of the error on a constant term (Holden and Peel, 1990). The test for biasedness is based on the regression expressed as:

$$e_t = \gamma + u_t \tag{1}$$

where e_t is the forecast error. In addition, unbiasedness is also important because it is a necessary condition for efficiency.

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Table III. Test for biasedness

	Current-year forecast		Year-ahead forecast	
	OECD	IMF	OECD	IMF
United States	0.01	−0.02	−0.09	0.14
	(0.97)	(0.93)	(0.71)	(0.67)
Japan	0.51	0.62	0.73	1.17
	(0.15)	(0.11)	(0.11)	(0.03)
Germany	−0.16	−0.06	0.04	0.43
	(0.52)	(0.84)	(0.92)	(0.27)
France	0.06	0.07	0.11	−0.31
	(0.78)	(0.75)	(0.72)	(0.08)
Italy	−0.51	−0.38	−0.43	−0.22
	(0.11)	(0.21)	(0.30)	(0.61)
United Kingdom	−0.47	−0.34	−0.22	0.13
	(0.01)	(0.13)	(0.61)	(0.78)
Canada	−0.24	−0.22	−0.03	0.24
	(0.34)	(0.44)	(0.94)	(0.54)

Notes: A test for biasness is based on the regression $e_t = \gamma + u_t$.
The figures in parentheses are the significance level of the t-statistic for $\gamma = 0$.

In Table III the value of the mean forecast error, γ, is shown and in parentheses are given the significance levels at which the null might be rejected. Generally, the evidence is that these forecasts are not biased, except in the case of the United Kingdom (OECD forecasts in the current year) and those for Japan made by the IMF in the fall for the following year. Also, a constant pattern of overestimation/underestimation (suggesting that there may be a widespread error of output growth optimism) is not detected.

When the forecast error is defined as the difference between the forecast and the real value, a positive (negative) value of γ and significantly different from zero points to an overestimation (underestimation) of the GDP growth. Hence, in the Japanese case is seen for the IMF a trend to overvalue the GDP growth in the forecasts made one year ahead, and in the United Kingdom's case there is confirmed an undervaluation of its growth for OECD forecasts made in the current year.

Forecast efficiency implies that the deviation between the outcome and the projection is not related to information available at the time that the projections were made (Holden and Peel, 1990; Barrionuevo, 1996). This condition is tested by measuring the statistical significance of the co-movements between the deviation of the outcome of the forecast and the forecast itself (β-test), and the co-movement between the deviation of the outcome of the forecast in the current period and that in the previous period (ρ-test). β is estimated by a least-squares regression of the forecast error on a constant and the forecast (equation (2)), and ρ is estimated by a regression of the current-period forecast error on a constant and the previous-period error (equation (3)). Thus, a condition for efficiency is that both β and ρ be zero.

$$e_t = \alpha_1 + \beta \cdot F_t + u_t \tag{2}$$

$$e_t = \alpha_2 + \rho \cdot e_{t-1} + u_t \tag{3}$$

where e_t and F_t denote forecast error and forecast, respectively.

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These equations provide a useful distinction between different forms of inefficiency (Barrionuevo, 1996). If β is zero and ρ is different from zero the forecast is inefficient because the errors of the past are repeated in the present, and hence forecasts could be improved by adjusting them by ρ. If β is different from zero and ρ is zero, the inefficiency arises because the model used to derive the forecast is not the minimum variance model. Finally, if β and ρ are both not equal to zero, the inefficiency is partly due to the way in which new information is incorporated into projected values and partly because the errors of the past are repeated in the present.

In Table IV we analyse the efficiency of the forecasts made by the OECD and the IMF in both temporal horizons considered. If a significance level $\alpha = 0.05$ is established, only in the case of forecasts made by the IMF one year ahead for Japan can it be rejected that $\beta = 0$ and $\rho = 0$, that is, the forecasts for the Japanese economy are inefficient, due to the fact that the past errors are repeated in the present ($\rho \neq 0$) and do not incorporate all available information at the time of making the prediction ($\beta \neq 0$). The forecast made by the IMF in the current year for France can also be considered as inefficient due to $\rho \neq 0$, that is, the past errors are repeated in the present forecasts.

A third case in which forecasts can also be considered as inefficient is when $\beta \neq 0$ and $\rho = 0$. This means that forecasts do not include all available information when they are made. In this situation are the OECD forecasts in the current year for the United States and the United Kingdom; the OECD forecasts in the current year and one year ahead for Japan; and the IMF forecasts in the current year for Japan.

It can be said that forecasts made by the OECD and the IMF for both temporal horizons are efficient, except in the case of Japan. In the same way, the OECD forecasts in the current year for the United States and the United Kingdom do not embody all available information when they are computed, and those for France by the OECD in the current year repeat the errors committed in the past. Among the cases studied only in two can it be accepted that $\rho = 0$ (the errors in the past are repeated in the present) and in six that $\beta = 0$ (forecasts do not embody all available information at the moment of being made). Curiously, they are slightly higher when efficiency is studied by forecasts made one year ahead, while it is not possible to differentiate between forecasts by the OECD and the IMF.

DIRECTIONAL ACCURACY

In the previous section the sizes of forecast errors have only been considered without considering their direction. An error in the forecast sign direction consists of an acceleration (deceleration) of growth forecast instead of the real deceleration (acceleration). The directional accuracy data can be arranged in a 2×2 contingency table. In Table V the columns are formed for forecasts of positive and negative changes and the rows for positive and negative realizations. It is obvious that the objective is that the sum of entries in the two cells of the leading diagonal ($n_{00} + n_{11}$) should be high.

A simple χ^2 test of independence can be supplied in this framework:

$$\hat{\chi}^2 = \sum_{i=0}^{1} \sum_{j=0}^{1} \frac{[n_{ij} - n_{i.} n_{.j}/N]^2}{n_{i.} n_{.j}/N}$$

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Table IV. Tests for efficiency

	β-test			
	Current-year forecast		Year-ahead forecast	
	OECD	IMF	OECD	IMF
United States	0.12	0.11	−0.01	0.11
	(0.04)	(0.09)	(0.93)	(0.28)
Japan	0.21	0.21	0.24	0.32
	(0.00)	(0.00)	(0.01)	(0.00)
Germany	0.05	0.08	0.09	0.15
	(0.64)	(0.40)	(0.51)	(0.28)
France	0.11	0.09	0.16	−0.08
	(0.09)	(0.21)	(0.15)	(0.19)
Italy	−0.11	−0.16	−0.00	−0.04
	(0.33)	(0.16)	(0.99)	(0.78)
United Kingdom	−0.18	−0.08	−0.02	0.01
	(0.01)	(0.35)	(0.90)	(0.94)
Canada	−0.07	−0.04	−0.05	0.03
	(0.28)	(0.60)	(0.65)	(0.82)
	ρ-test			
	Current-year forecast		Year-ahead forecast	
	OECD	IMF	OECD	IMF
United States	−0.02	−0.02	0.07	−0.21
	(0.94)	(0.93)	(0.34)	(0.34)
Japan	−0.22	−0.02	0.24	0.42
	(0.24)	(0.90)	(0.26)	(0.04)
Germany	−0.08	0.24	−0.06	0.16
	(0.71)	(0.25)	(0.78)	(0.48)
France	0.36	0.42	0.14	0.07
	(0.07)	(0.04)	(0.51)	(0.34)
Italy	0.29	0.20	0.26	0.22
	(0.16)	(0.31)	(0.23)	(0.29)
United Kingdom	0.35	0.26	0.22	0.35
	(0.08)	(0.22)	(0.30)	(0.09)
Canada	0.25	0.06	0.10	0.05
	(0.24)	(0.80)	(0.66)	(0.81)

Notes: The β-test is based on the regression $e_t = \alpha_1 + \beta \cdot F_t + u_t$ and the ρ-test on the regression $e_t = \alpha_2 + \rho \cdot e_{t-1} + u_t$. The figures in parentheses are the significance levels of the t-statistic for $\beta = 0$ or $\rho = 0$.

where the null is that forecasts and realizations are independent (see Schnader and Stekler, 1990; Stekler, 1994; Leitch and Tanner, 1995; Artis, 1996). Rejection of this hypothesis implies that there is a significant association between the signs of realizations and forecasts. This analysis has been based exclusively on the signs of the predicted and actual changes and has, consequently, ignored quantitative errors (small and large errors are treated equally in this classification scheme).

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Table V. Contingency table form for directional accuracy

	Forecast		
	$\Delta F > 0$	$\Delta F \leqslant 0$	Subtotal
Realization			
$\Delta R > 0$	n_{00}	n_{01}	$n_{0.}$
$\Delta R \leqslant 0$	n_{10}	n_{11}	$n_{1.}$
Subtotal	$n_{.0}$	$n_{.1}$	N

Table VI presents the number of correct and incorrect direction forecasts that were made by the two organizations. The accuracy of the forecasts generally increases with a decline in the forecast horizon. Both organizations had similar forecasting experiences over the time period which was considered, although it can be said that those made by the OECD are slightly better. In the same way the independence between the forecasts' sign and the realizations can be accepted in the case of Italy in the OECD forecasts made one year ahead and in the IMF forecasts in both temporal horizons considered, especially the IMF forecasts for the Japanese economy in both temporal horizons.

CONCLUSIONS

This paper evalutes the accuracy of forecasts in the G7 countries produced by the OECD and by the IMF. Two sets of projections are examined: the current-year forecasts prepared in the spring of the same year, and year-ahead forecasts made in the fall for the following year. The results of a number of empirical tests support the following conclusions:

- The summary statistics clearly support the propositions that OECD forecasts are superior to the IMF forecasts, and that current-year forecasts are better than the longer-term year-ahead projections.
- The results reviewed in Table II do not afford a basis for a strong verdict either way on whether forecasting errors have fallen over the period.
- A constant pattern of overestimation/underestimation (suggesting that there may be a widespread error of output growth optimism) is not detected.
- OECD and IMF forecasts in both temporal horizons can be considered as efficient, except in the case of Japan. In the same way, the OECD forecasts for the current year for the United States and the United Kingdom do not embody all available information at the time of being made, and those for France by the OECD in the current year repeat the errors of the past.
- When forecast efficiency is studied it is concluded that forecasts made one year ahead are better than those of the current year, while it is not possible to differentiate between OECD and IMF proposals.
- Analysis based exclusively on the signs of predicted and actual changes shows that the independence hypothesis can be accepted between the forecasts and the actual values in the Italian case (OECD forecasts one year ahead and IMF in both temporary horizons) and Japan (the IMF in both temporal horizons), while in other countries this hypothesis can be rejected. Moreover, GDP growth direction forecasts made by the OECD are slightly higher than those of the IMF, and, finally, accuracy of the forecasts generally increases with a decline in the forecast horizon.

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Table VI. Contingency table of directional forecast accuracy

	Current-year forecast—OECD				
	$\Delta R > 0, \Delta F > 0$	$\Delta R > 0, \Delta F \leqslant 0$	$\Delta R \leqslant 0, \Delta F > 0$	$\Delta R \leqslant 0, \Delta F \leqslant 0$	χ^2
United States	8	2	1	13	14.31[a]
Japan	13	1	2	8	14.31[a]
Germany	9	2	2	11	11.40[a]
France	8	2	2	12	11.11[a]
Italy	9	3	3	9	6.74[a]
United Kingdom	12	3	0	9	15.38[a]
Canada	10	1	0	13	21.28[a]
	Current-year forecast—IMF				
	$\Delta R > 0, \Delta F > 0$	$\Delta R > 0, \Delta F \leqslant 0$	$\Delta R \leqslant 0, \Delta F > 0$	$\Delta R \leqslant 0, \Delta F \leqslant 0$	χ^2
United States	8	2	2	12	11.40[a]
Japan	11	3	3	7	6.58[b]
Germany	9	2	3	10	9.00[a]
France	7	3	2	12	8.36[a]
Italy	7	5	4	8	1.92
United Kingdom	10	5	0	9	11.11[a]
Canada	9	2	1	12	14.49[a]
	Year-ahead forecast—OECD				
	$\Delta R > 0, \Delta F > 0$	$\Delta R > 0, \Delta F \leqslant 0$	$\Delta R \leqslant 0, \Delta F > 0$	$\Delta R \leqslant 0, \Delta F \leqslant 0$	χ^2
United States	6	2	0	14	15.65[a]
Japan	9	4	3	6	1.96
Germany	7	2	3	10	7.33[a]
France	7	2	4	9	5.49[b]
Italy	6	4	6	6	0.43
United Kingdom	9	4	1	8	7.99[a]
Canada	8	2	1	11	12.61[a]
	Year-ahead forecast—IMF				
	$\Delta R > 0, \Delta F > 0$	$\Delta R > 0, \Delta F \leqslant 0$	$\Delta R \leqslant 0, \Delta F > 0$	$\Delta R \leqslant 0, \Delta F \leqslant 0$	χ^2
United States	5	3	3	11	4.71[b]
Japan	9	4	4	5	0.88
Germany	8	1	4	9	8.07[a]
France	7	2	5	8	3.97[b]
Italy	6	4	4	8	2.11
United Kingdom	9	4	2	7	5.32[b]
Canada	8	2	1	11	12.61[a]

Notes: F and R denote forecast and realization, respectively. $\Delta R = R_t - R_{t-1}$ and $\Delta F = F_t - R_{t-1}$. (a) indicates that the null hypothesis of independence can be rejected at the 1% significance level and (b) at the 5% significance level.

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